agricultural research

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Harvest Home

A mood of autumnal fulfillment settles upon the land. Now the human spirit transcends the melancholy that ensues when the foliage flames no more and life moves into the drab days of November. The cold wind increasingly descends from the north, its frosty chill withering the grass. Cattle huddle forlornly, tails to the wind, but their masters know the satisfaction that comes with harvest home—let winter's worst come, there will be life in barns and houses.

Another year has turned on the vast stage of nature. Countrymen everywhere have toiled through the seasons of preparation, growth, and harvest and now pause to enjoy and celebrate a period of fulfillment. These cyclic tasks of husbandry are ancestral rites, lost in the dimness of the ages. They embrace what is most elemental and eternal in mankind. In today's industrial society, however, they seldom touch the lives of townsmen.

Lacking ties with agriculture, the average townsman tends to take his daily bread for granted. Indeed, relatively few people fully grasp the miracle of plenty that American agriculture has wrought in the three centuries since that bleak and hungry winter which direly tested the Pilgrims at Plymouth. With the passing years farmers and food processors have provided food in rich variety. For example, when Abraham Lincoln clerked in a food store his customers could choose from perhaps 900 food items. Today a typical supermarket teems with such an array of foods—8,000 and more items—that shoppers are often faced with delightful indecision.

The unheralded farmer not only produces food abundantly, but efficiently. Less than 16 percent of the Nation's take-home income goes to pay for food bills. And in a world that is striving to win the race between the stork and the plow, the American farmer produces enough to feed 41 people at home and seven abroad. By contrast, in much of the world agriculture ties up most of the labor force, and people frequently spend half and more of their income on food.

Those who till the land, of course, do not work alone in the Herculean task of feeding people. They have the support of others in a complex food system that assembles, transports, processes, packages, and merchandises the foods that fill our market baskets. They are also aided by agricultural scientists who are helping set the pace for the unprecedented technological achievements of American agriculture. All these dedicated people come in for a share of thanks as families gather gratefully around their tables in this season of harvest home.

Editor: R. P. Kaniuka
Editorial Assistant: M. J. Phillips
Contributors to this issue:
R. C. Bjork, V. R. Bourdette,
J. P. Dean, V. M. Dryden,
W. W. Martin, M. A. Neubauer,
M. E. Nicholas, E. L. Razinsky,
D. H. Senft, D. M. Webb

COVER: Supported on buoyant water shoes, Willey Durden sweeps flea beetles from a mat of devastated alligatorweed on South Carolina's Edisto River for release in other infested areas. When the plants refoliate, the beetles will return to destroy any growth above water. Repeated defoliations force the weakened plant to deplete its available food supply causing it to succumb to flood, competitive plants, and nutritional factors. Story begins on page 6 (0872X1187-30).

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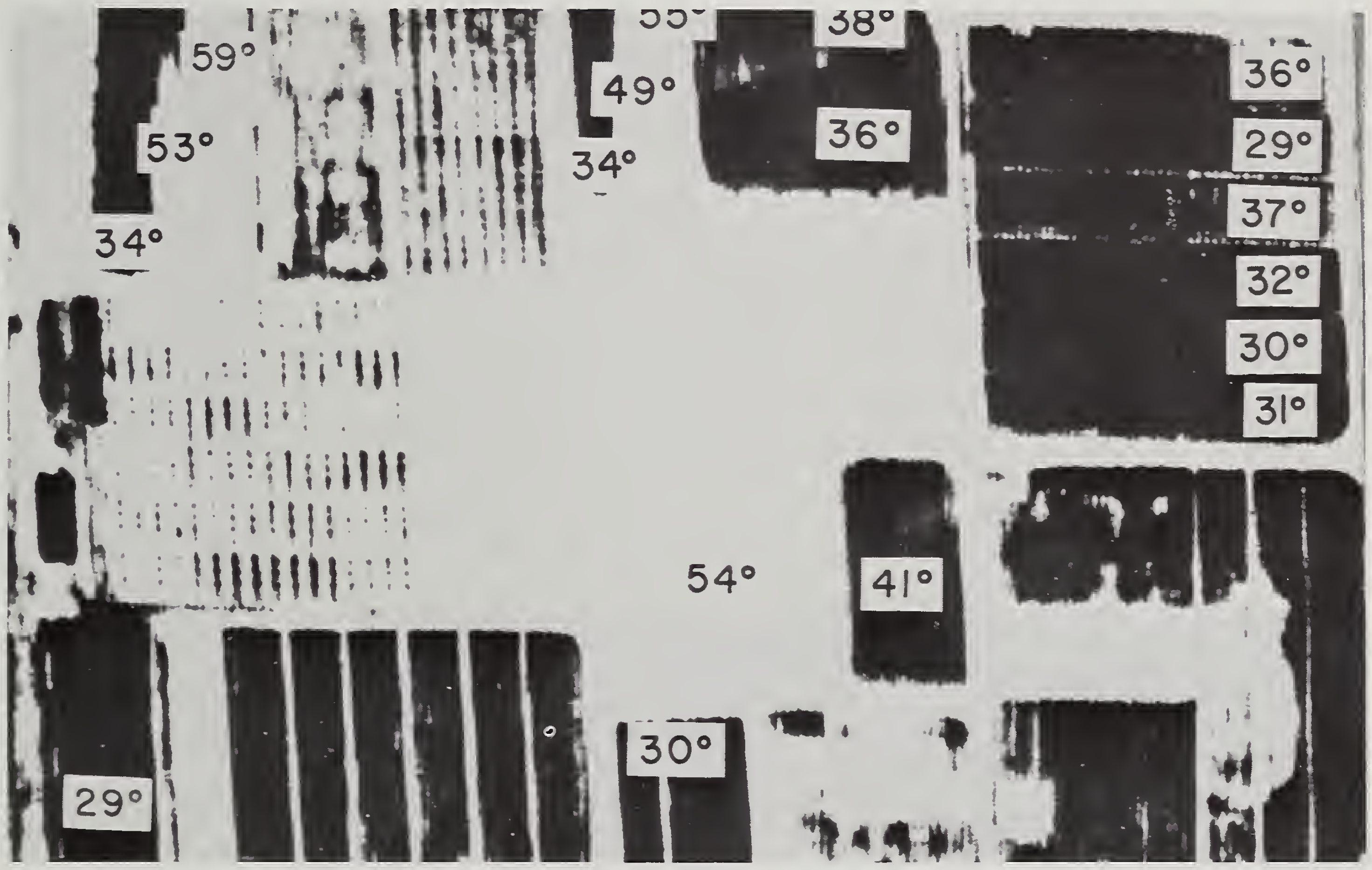
Earl L. Butz, Secretary
U.S. Department of Agriculture

Talcott W. Edminister, Administrator
Agricultural Research Service

A Look at the Earth's Temperature



This enlarged thermal image was obtained from the airplane-mounted thermal scanner as it flew along the flight line over the research farm near Weslaco, Tex. The dark areas are cool and average blackbody temperatures are shown for wet, intermediate, dry, and tilled soil treatments (PN–2803).

A FARMER PONDERS whether to irrigate—waiting too long may reduce crop yield or quality, but premature irrigation would waste water.

After irrigation, he wonders if the application rate was uniform.

To adjust irrigation scheduling after a rain, he needs to know how much rain fell on each field.

After seeding a crop in midsummer, he considers whether he should cool the soil by irrigating to enhance germination or protect emerging seedlings from heat damage.

Or, on cold winter or spring nights, he wonders if freeze protection is needed on sensitive crops.

In all five situations, farmers may one day be guided in their decisions by information on soil and plant canopy temperatures gathered by an airplane-mounted thermal scanner. The feasibility of this method for obtaining temperature data quickly in large irrigated areas was established in preliminary studies by ARS scientists at Weslaco, Tex., in cooperation with the Texas Agricultural Experiment Station, College Station.

In contrast, identifying water-stressed plants by temperature measurements made with radiation thermometers or other ground-based sensors is too cumbersome for use on more than a small area of a field.

Former ARS soil scientist Jon F. Bartholic and ARS soil scientists Leo N. Namken and Craig L. Wiegand col-

lected temperature data with an object plane scanner mounted in a commercial plane flying at about 2,000 feet. The scanner mirror, rotating at right angles to the flightpath, makes about 200 scans per second with each scan covering a ground area almost 3,000 feet wide. Data were recorded both on film and on analog tape for computer analysis.

Before the overflights, the scientists timed irrigations of replicated cotton plots to provide severe, moderate, and no water stress on the plants. They also established dry, moderate, and wet moisture conditions in bare soil plots. Temperature, soil water content, plant water stress, and other environmental measurements made on the ground about the time of the flights provided data for comparison with that obtained with the plane-mounted sensor.

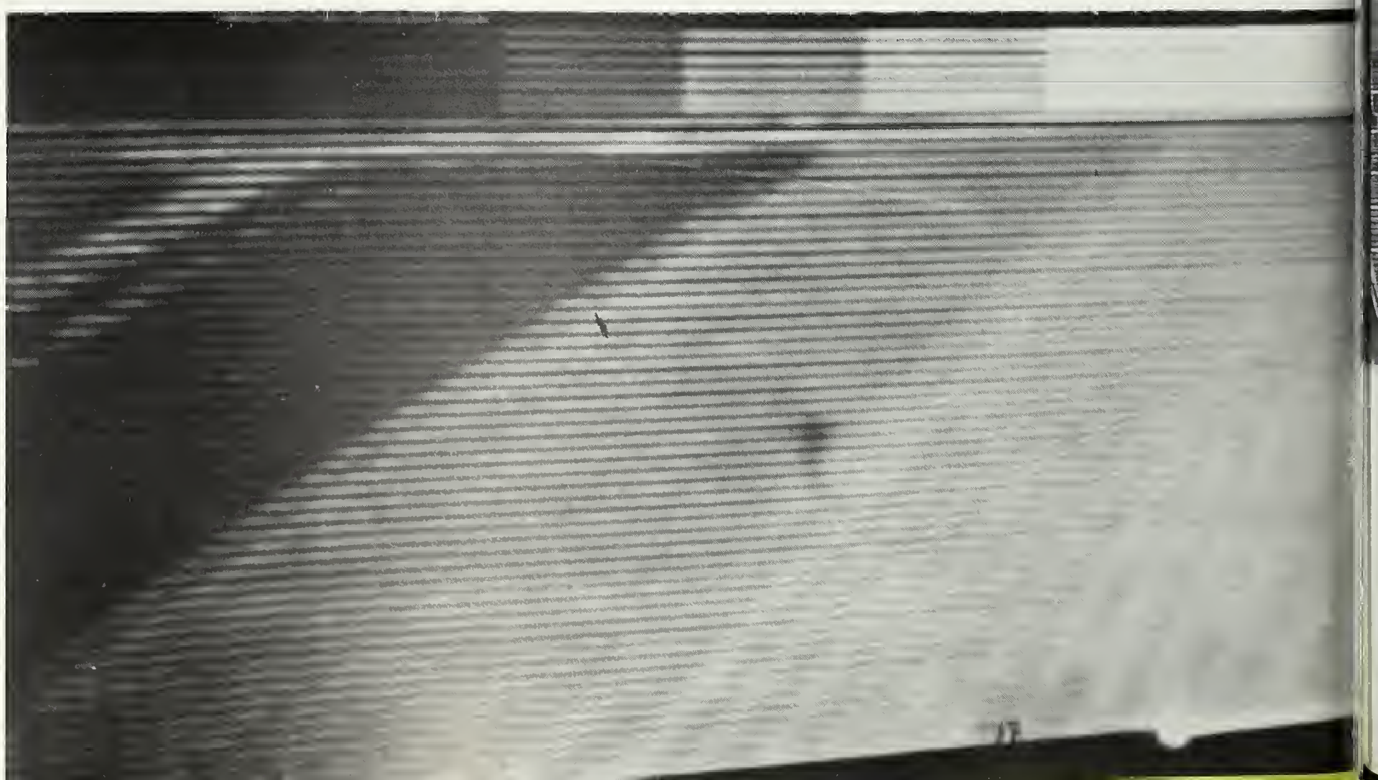
Dr. Bartholic and his colleagues used a very sensitive microdensitometer to measure film density differences in the thermal imagery. They found that remotely sensed cotton canopy temperatures accurately identify variations in soil water content. Calculated canopy temperatures were 36 and 37° C. for severely stressed plots, 31° C. for moderately stressed, and 29 and 30° C. for unstressed. Corresponding soil water content measurements in the surface 3 feet were 9.8 and 9.6 percent; 14 percent; and 15 and 18 percent.

On bare plots, remotely sensed temperature measurements likewise accurately identified dry (59 and 55° C.), intermediate (53 and 49° C.), and wet soil (34 and 34° C.). A third set of observations was made in a field in which disking was begun about 30 minutes before the fight. The untilled bare soil was much warmer (54° C.) than the freshly tilled soil (41° C.). Moreover, the scientists could identify the soil area that had been tilled first and had started to dry and warm up.

Remotely sensed temperature measurements varied only 0.8 to 1.9° C. from those made on the ground with a precision radiation thermometer.

The scientists concluded that thermal imagery may aid in delineating water-stressed and nonstressed fields, and in evaluating uniformity of irrigation and surface water conditions. □

Left: A regular photograph of the three soil irrigation treatments. ***Below:*** *Thermal image obtained with ground based thermal scanner of the same area shown at left (PN–2804).* ***Right:*** *An over-all image of area surrounding the research farm (outlined in center of image). Again, dark areas represent cool temperatures. Gray scale steps are shown near the edge of the film and the two calibration source lines are outside the gray scale step area (PN–2805).*



Coming up short at Harvest time

SCIENTISTS have demonstrated in field experiments that ozone, a major component of air pollution, reduces yield in an agricultural crop.

Previously, the deleterious effects of air pollutants have been mainly demonstrated and measured by visible injury to plants or by physiological responses of plants in the laboratory.

Now the proof is in—ozone reduces yield in sweet corn. Field studies on other crops are underway.

Motor vehicle exhaust is the primary source of ozone. It is formed as sunlight reacts with the products of motor fuel combustion.

ARS plant pathologist Allen S. Heagle conducted the pollution study at Raleigh, N.C., in cooperation with mechanical engineer Denis E. Body and biologist Evelyn K. Pounds of the Environmental Protection Agency.

The scientists exposed Golden Midget and White Midget, both well-known sweet corn varieties, to charcoal-filtered air containing 0, 5, or 10 parts per hundred million (pphm) of ozone for 6 hours each day from the time the corn emerged until harvesting. These doses of ozone are lower than those commonly found in many urban areas.

The corn was grown in 20 8- by 8-foot plots in field exposure chambers of clear plastic film. Ozone caused more visible injury and greater reductions in growth and yield of Golden Midget than White Midget. These findings confirm many observations that some varieties of crop plants are more tolerant to pollutants than others.

In Golden Midget corn, the studies showed that the higher the ozone concentration, the greater the reductions in the number of ears with kernels, the amount of ear fill, and the number of kernels per ear and dry weight of the kernels. For example, the average number of kernels per ear in ozone-free air was 373, while in 10 pphm ozone the number was 288. The dry weight of kernels in 0 ozone averaged 43.6 grams, and averaged 23.8 grams in 10 pphm ozone. Moreover, there was leaf injury, the plants were somewhat shorter, and weighed less.

The major effects of ozone on White Midget occurred in yield associated with seed set. Ozone caused no leaf injury or decrease in plant size. This suggests that in some varieties the physiological processes necessary for successful seed set are more sensitive to ozone than other plant growth processes. The number of kernels per ear in White Midget averaged 285 in ozone-free air and 197 in air containing 10 pphm ozone. The dry weight of kernels averaged 24 grams in ozone-free air and 16 grams in air containing 10 pphm ozone.

Because the ozone levels used in this study were lower than the levels commonly found in many large urban areas, the results suggest that yield loss in corn due to air pollution may be greater than previously realized.

Currently, air pollutants of most concern to vegetation include ozone, PAN (peroxyacetyl nitrate), sulfur dioxide, and fluoride. In this country, ozone is the major pollutant affecting plants. □

Right: *An alligatorweed-tangled propeller plagues fishermen on a once clear-running bayou near Lake Pontchartrain, Louisiana. The voracious appetite of the flea beetle* Agasicles *may change things (0872X1189–17).* ***Below left:*** *On Florida's Ortega river—site of the first successful establishment of* Agasicles *in the United States—ARS entomologist Neal R. Spencer, and Charles F. Zeiger of the U.S. Corps of Engineers examine beetle-damaged alligatorweed. The 1965 release of 267 beetles in this area has proved so successful that the Ortega river at Jacksonville is now the primary collection point of beetles for release throughout the Southeast (0872X1184–10).* ***Below right:*** *In a greenhouse converted to a rearing room, laboratory assistant Deborah K. Beasley collects larvae of* V. malloi *from a mat of heavily infested alligatorweed. Moths reared at this Gainesville facility are released throughout the Southeastern seaboard to combat alligatorweed (0782X1179–20).*

Little bugs tackle big

problem

Natural enemies of alligatorweed are providing good control of this scourge of many Southern waterways and offering a desirable alternative to conventional herbicides.

Alligatorweed is costly to control through conventional methods—about $30 per acre—because of its high tolerance to herbicides. Moreover, it grows more aggressively than do other easily controlled aquatic plants which subsequently become crowded out. Chopping or cutting alligatorweed once provided temporary control, but proved to perpetuate the problem because floating fragments often rooted elsewhere.

This major aquatic pest first infested Florida waterways about 80 years ago, and has since spread over more than 66,500 acres in nine Southeastern States plus small areas in Arkansas, California, and Tennessee.

Alligatorweed has many liabilities and few assets. It renders waterways unnavigable, interferes with fishing and other aquatic sports, contributes to flooding by blocking the drainage of canals, and creates a favorable breeding habitat for mosquitoes. It does provide some forage for livestock, but this is outweighed by its pernicious qualities.

The most recent successful control of alligatorweed was scored in an 800-acre area that includes parts of Lake Pontchartrain and its tributaries north of New Orleans, La. There, a tiny flea beetle, *Agasicles hygrophila*, is curbing alligatorweed without any help from herbicides. The flea beetle, originally obtained from Argentina, provided similar success in earlier tests in Florida (AGR. RES., Feb. 1967, p. 10).

Like many imported pests, alligatorweed arrived in the United States without its natural enemies. To redress this biological imbalance, ARS entomologist George B. Vogt explored the weed's South American homeland for its natural enemies and collected some 40 promising species of insects. Three species were brought back after tests showed they did not harm useful plants.

In recent years, about 200,000 adults of the most promising species, the *Agasicles* flea beetle, have been collected at original U.S. release sites and relocated throughout infested parts of eight Southeastern States and California by ARS entomologists and staff of the U.S. Army Corps of Engineers. The progeny of these beetles number in the millions.

Both the adult and larval stages of the flea beetle feed on the leaves and stems of alligatorweed above the waterline, severely reducing photosynthesis—the manufacture of plant food. Later, larvae bore into the plant's hollow stems and complete their pupal stage there. The flea beetle takes 25 days to grow from egg to adult, then lives about 48 more days.

The beetle multiplies rapidly, producing up to 1,000 eggs per female. In South America it produces five generations annually, steadily applying pressure on the weed during its periods of fastest growth in spring and fall. In Florida and Louisiana, where the beetle's population reaches its peak in the spring, good alligatorweed control occurs because the plant's rapid growth at this time reduces its carbohydrate resources to a minimum. Lacking energy to generate new growth, the weed dies or is weakened sufficiently to be finished off by greater competition

***Top of circle:** Twisted, dying alligatorweed leaves (left) tell the presence of* Amyothrips andersoni, *the subminiature thrips imported to fight the plant pest. On the right are normal healthy leaves (0872X484–14). **Left:** A well camouflaged* V. malloi *moth clings to the dry stem of alligatorweed. Like other moths,* V. malloi *is shy, hiding among dead alligatorweeds by day and feeding by night (9872X1190–9) **Center:** The tiny flea beetle,* Agasicles hygrophila *(0872X1180–20). **Right:** A hollowed but stem of dead alligatorweed attests to the ravenous appetite of* V. malloi *larvae (0872X1181–0).*

from other aquatic plants, invasion by plant disease organisms, and by wind and wave action which destroys its intertwining mats which may extend as far as 50 feet from rooted portions near the shore.

To increase the beetle's effectiveness north of Florida and Louisiana, hardier strains are being sought in Argentina. Integrated control measures may be feasible until the beetles or other biological controls prove effective alone in northern areas.

In South Carolina tests, technician Willey Durden and botanist Robert D. Blackburn of ARS controlled alligatorweed by integrating biological and herbicidal control. They sprayed weeds at a low rate—2 pounds of 2,4-D per acre—only one-third as much herbicide as when it is used alone. When the regrowth of surviving weeds reached a height of 6 to 8 inches, they released 100 to 200 flea beetles per 10 acres. As in other experiments, feeding damage resulted mainly from these beetles' progeny, numbering several thousand. The scientists reported better results than when either biological or herbicidal control was used alone.

Two other weed-eating insects from South America are aiding the biological attack on alligatorweed by flea beetles. One is a moth, *Vogtia malloi,* which is active in midsummer when flea beetles are quiescent. The female moth lays about 260 eggs on the tips of alligatorweed foliage. Upon hatching, this moth's caterpillars girdle the weed's stems, cutting off the flow of water and nutrients, causing the plants to collapse.

The other beneficial insect is a thrips, *Amynothrips andersoni.* It complements the *Vogtia* caterpillars and flea beetles by feeding on alligatorweed that grows on the banks or extends inland from waterways. Larval and adult thrips feed on new growth, stunting the weed and curling the leaves. Unlike many species of thrips, *A. andersoni* is not a pest of cultivated crops.

The National Institute of Agricultural Technology, Buenos Aires, Argentina, and the University of the Republic, Montevideo, Uruguay, participated in the tests, which were funded by the U.S. Army Corps of Engineers.

The Florida Department of Natural Resources recently provided funds for the continuation of aquatic studies. The Florida Agricultural Experiment Stations also cooperated in part of the research. □

Far left: Scales in hand, University of Florida graduate student John L. Brown develops data on stress that V. Malloi *induces on the plant's root system by weighing a core sample of alligatorweed from an infested creek on the University campus. In one respect alligatorweed is like an iceberg: the bulk of its mass lies below water (0872X1183–17).* ***Upper left:*** *Neal R. Spencer (left) and Willey Durden release beetles collected from sites where* Agasicles *has prospered. This weed-congested stream is in South Carolina (0872X1185–23).* ***Lower left:*** *An airboat glides effortlessly through a bayou near Lake Pontchartrain that heretofore was completely choked with alligatorweed. Donald Lee, Louisiana Wildlife and Fisheries Commission Aquatic Weed Control Coordinator, and William E. Thompson, Chief of the Aquatic Growth Control Section of the U.S. Corps of Engineers in Louisiana inspect an area where* Agasicles *has done its work (0872X1188–23).*

ARS entomologist Neal R. Spencer inspects root system of water hyacinth, a species likely to invade waters after alligatorweed is under control (0872X1178–10).

ECOLOGICAL VIGILANCE

Successful biological control requires vigilance against any possible adverse consequences. ARS scientists, for example, note that where alligatorweed has been controlled biologically, waterhyacinth takes over as the dominant aquatic weed. Rather than permit one biological solution to give rise to another problem, scientists plan to introduce insects that feed on the newcomer. Of some 30 such insects found in South America, three are now under test as biological agents. Two are related weevils, *Neochetina eichhorniae* and *N. bruchi;* the third is a moth, *Acigona infusella.*

To make certain that biological control of alligatorweed and water-hyancinth does not cause other ecological upsets, ARS scientists are keeping an eye on European water-milfoil. This submerged aquatic weed, now found in at least 22 States, may succeed the two aquatic pests should their numbers diminish.

The goal of biological control of aquatic weeds is not total eradication. Scientists are trying to hold down populations of pest plants to economically manageable levels without causing any undesirable side effects.

Gasses accelerate stem rust life cycle

PLANT SCIENTISTS are speeding up a biological process in an effort to control a disease that each year destroys many thousands of bushels of wheat.

At the Epiphytology Research Laboratory, Frederick, Md., ARS plant physiologist Richard C. French is working with stem rust, a fungus disease that parasitizes wheat, barley, and wild grasses, competing with them for water and nutrients.

In earlier work, Dr. French and his colleagues discovered that the uredospores of the fungus, the "seeds" from which the fungus grows, contain n-nonanal (pelargonaldehyde), a substance which stimulates germination of the spores.

Dr. French and colleague Milton D. Gallimore combined knowledge of germination stimulators and rust life cycle to develop a potential control technique.

In the present research, they subjected rust-infected wheat plants to nonanal and related compounds in gaseous form under ideal spore germination conditions. The aim of the treatment was to induce the normally dormant spores to germinate in the pustule instead of going to another leaf. This would immobilize spores at a site unfavorable for growth and make them extremely vulnerable to injury.

After exposure to the stimulants virtually all pustules on treated plants were cottony white from massive germination of spores. Rust-infested plants, handled in a similar manner but not exposed to the stimulator, exhibited no germination of spores.

Results indicated that germination of spores in the pustule could be induced, thus effectively preventing further spread. Development of long, intertwined germ tubes acts somewhat like a cotton plug, restraining the ripening spores and preventing dispersal.

The chemicals involved are inexpensive and effective at great dilution; a pound of octanol, costing about $2.80, could make 50,000 gallons of spray. These substances have been components of foods in human diets for centuries. Related substances, nonanol, for example, have been found to stimulate spore germination. Nonanal, for example, is a component of the flavor and fragrance of a great variety of natural products, ranging from essential oils such as rose, cinnamon, and various citrus, to rancid peanut oil and meat.

Dr. French explains that the greatest obstacle to practical use of the technique in the field is lack of a means to hold the highly volatile stimulator and water at the pustule site for the several hours needed for germination.

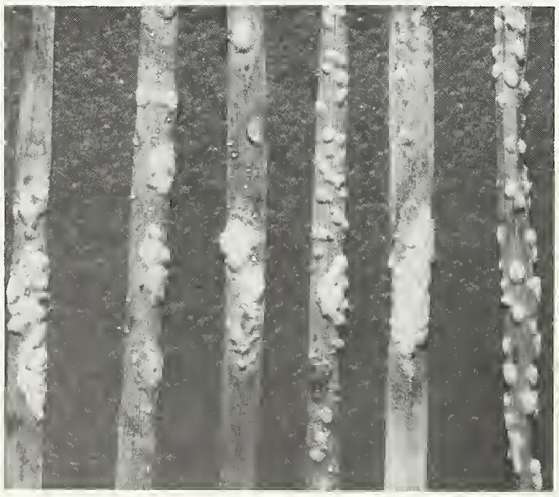
"If this technical shortcoming could be economically solved, the technique would hold some potential for disease control, particularly during severe epidemics," he says.

Chemicals used in these studies are not registered for any of the uses evaluated. Before a chemical can be released to the public, it must undergo stringent tests by its processor, who then submits test data and the product to the Federal Government for evaluation and registration. ☐

Wheat stem rust is characterized by pustules or blisters that develop and break through the surface of the stems, leaves, and sheaths of the wheat plant. Thousands of brick-red spores escape from the pustules and are carried by the wind to infect other wheat plants.

Spores fall on wheat leaves and may germinate in warm, humid weather. They remain dormant if conditions are not suitable. Germinating spores send out germ tubes, which grow along the surface of the leaf or stem until they reach a breathing pore (stoma), where they enter, send out branches that grow within the tissues of the plant, draw nourishment from them for a week or more, then produce the red pustules with another crop of spores.

Wheat leaves after an overnight treatment in a dew chamber. The leaves at the left were treated with nonanol, a germination inducing chemical; note the white, fluffy germ tubes produced by the spores that have germinated. The leaves at right are controls which did not receive nonanol treatment; spores are still contained in the pustules (PN–2806, PN–2807).



New vaccine vs. old virus

MENTION CALF SCOURS to a cattleman, and he can feel a knot in his stomach and a hole in his pocketbook. Even with present vaccines and antibiotics, cattlemen lose an estimated 10 percent of their calf crop each year. Bovine viral diarrhea (BVD) is a major cause of such losses.

Vaccines now used for BVD are made from weakened live-viruses, which may cause severe post-vaccinal reactions, abortions in cows, and infertility in bulls. These vaccines are meant for calves from 6 to 9 months of age, but are used extensively on younger calves. In very young animals, these vaccines can be hazardous and may even cause a mild clinical BVD infection.

ARS scientists George Lambert, Albert L. Fernelius, Leslie G. Classick, and Robert L. Smith of the National Animal Disease Laboratory, Ames, Iowa, have developed a promising new vaccine which could eliminate most problems associated with present vaccines.

The experimental vaccine is made from a strain of inactivated BVD virus. It will still produce an immune response in cattle without the risk of spreading live virus to susceptible cattle.

In production of the experimental vaccine, microbiologist Dr. Albert L. Fernelius mixes an inactivating agent into a beaker of BVD virus. The virus is propogated in incubation rooms where it feeds and multiplies by destroying bovine turbinate cells taken from the noses of healthy laboratory animals (0872X1213-13).

Research veterinarian Dr. Charles W. Beal extracts a blood sample from a vaccinated calf. A count will then be made of the number of BVD fighting antibodies present. Assisting Dr. Beal are Dr. Fernelius and an ARS animal caretaker (0872X1214-5).

In tests at the laboratory, the vaccine was evaluated for safety and potency in 75 calves and cattle of all ages. There were no postvaccinal reactions. Moreover, the vaccine's safety was confirmed by the absence of any clinical or serologic signs of disease in the nonvaccinated susceptible calves held in contact with the vaccinated calves before exposure to virulent BVD virus. After exposure, a high level of protection was demonstrated in the vaccinated calves. The nonvaccinated control calves had diarrhea, fever, and loss of appetite.

The vaccine proved safe, effective, and versatile. It could be used on cattle of all ages and sexes, and even on pregnant cows. Field tests and extensive evaluation plus approval by USDA's Animal and Plant Health Inspection Service are necessary before the vaccine can be made available to industry. □

Bovine viral diarrhea is one of the major economic problems of the cattle industry. An estimated 4 million calves die from this and related enteric diseases each year.

BVD is most serious in young calves. Affected animals have elevated temperatures, persistent diarrhea, and loss of appetite. Many calves die. However, even calves which survive are weakened and susceptible to other infections. Recovered cattle also suffer a setback and rarely reach their full potential. BVD is also especially troublesome in cattle under crowded conditions, such as in feedlots.

In cows, BVD may cause a drastic reduction in milk production and abortion in pregnant animals. In bulls, infertility may result.

Cleaning our streams with cotton

TWO COTTON SCIENTISTS may have opened the way to winning another battle in the immensely complex war on pollution. They have discovered several chemical treatments that may prove to be keys in removing mercury from water.

The treatments can be used to make cotton, or almost any other cellulosic material, such as peanut hulls, a highly efficient "trap" for water-borne heavy metals. The trap can be regenerated for repeated use.

There are several means for removing large amounts of mercury from industrial effluents, but removal below 100 parts of mercury per billion parts of water has proved very difficult and costly. The new treatments are capable of reducing the mercury content of contaminated water below the 5 parts per billion (ppb) now permitted in drinking water.

Chemists Earl J. Roberts and Stanley P. Rowland, Southern regional research laboratory, New Orleans, La., are engaged in research to develop new durable press finishes for cotton with emphasis on a finish that would allow introduction of creases into treated fabrics designed for the home seamstress.

During the course of their research, the chemists recognized that theoretically the structure of the chemicals being used was such that the nitrogen atoms were in positions that would give them a high affinity for metal salts, particularly the salts of heavy metals.

Cotton fabrics chemically modified with four compounds were used in the bench-scale efforts to remove mercury salts from water. The compounds were crosslinked polyethylenimine (CPEI), 0-(2-Aminoethyl) (AE), Polyethylenimine (PEI), and 0-(2-Diethylamine)ethyl (DEAE). Their relative effectiveness decreases in the order listed.

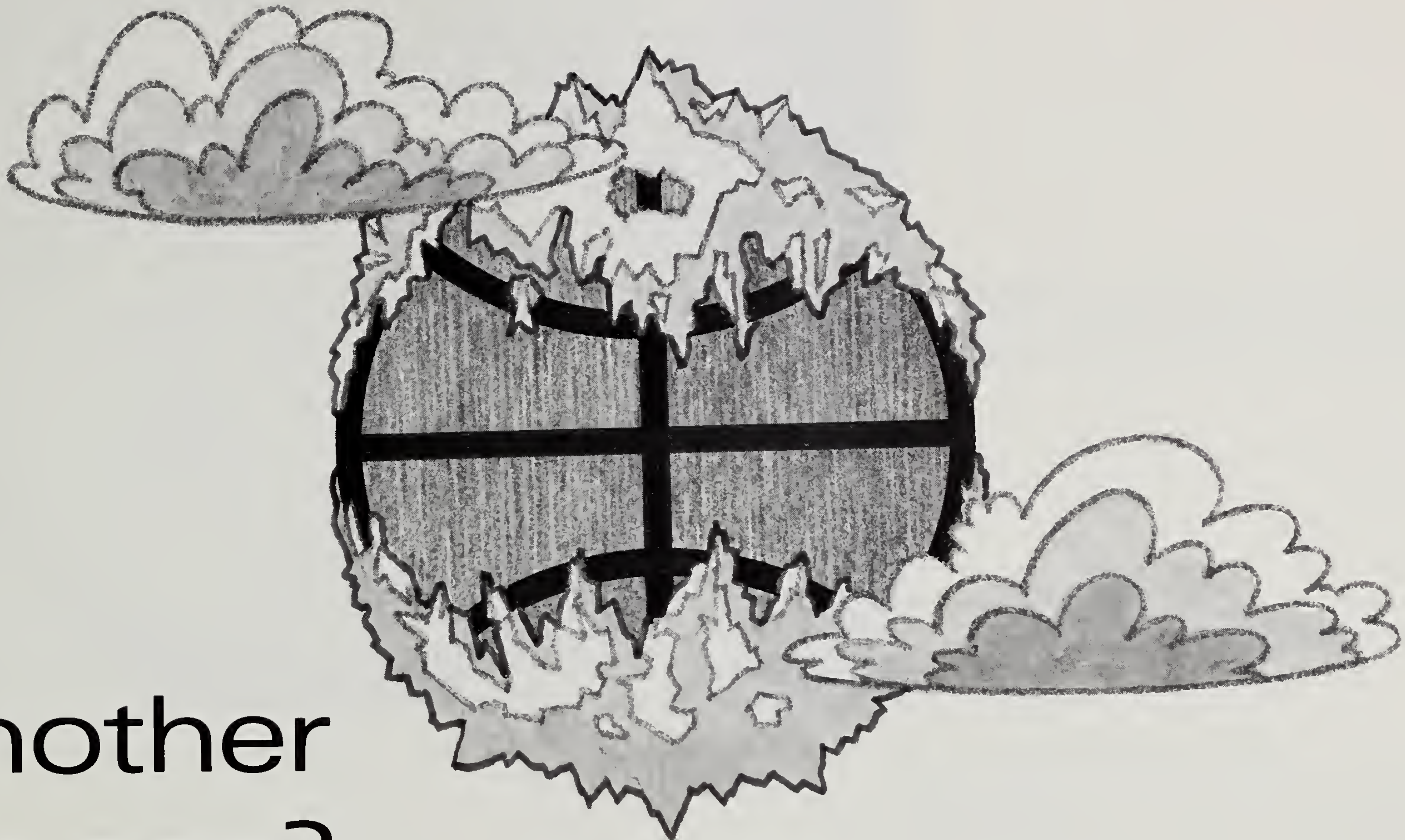
Cotton can be treated in any form from chopped fibers to woven or knitted fabric; the chemical add-ons can be made as high as 50 percent of the original fabric weight.

Fabric treatments differ slightly with each chemical compound, but all are simple and can be accomplished on standard textile finishing equipment such as that used in treating durable press cottons.

The treated cottons can be regenerated and cleared of mercury or other metal salts by washing in solutions of sodium citrate, disodium ethylenediaminetetraacetic acid (EDTA), or sodium tiocyanate. The salts can then be precipitated out of the concentrated solutions or reduced to metal by conventional chemical procedures.

The treatments offer intriguing possibilities for reducing the alarming concentrations of mercury being dumped into many of the nation's streams and lakes. For example, a continuous belt of fabric could be passed into a mercury polluted stream to absorb the mercury, squeezed through rolls to remove excess water, and immersed in a regenerating bath. Then, washed free of the regenerating bath, the cotton could be returned to the stream to continue scavenging for mercury. □

ARS chemist Earl J. Roberts adds treated cotton fibers to a water solution containing mercury. The treated cotton will complex with the mercury and effectively remove it from the water (PN–2808).



Another ice age?

SCIENTISTS theorizing that volcanic dust and man's industrial activities are spewing enough particulate matter into the atmosphere to bring on another ice age have a challenger.

For years, scientists have thought that if the mean atmospheric dust concentration were to be sizably increased by either of these means, a cooling of the earth's climate would shortly ensue. The reason generally given is that an increased quantity of atmospheric dust would reflect away from the earth—back scatter—a larger amount of solar radiation than at present, and this reflected radiation would otherwise be available for terrestrial heating.

ARS soil scientist Sherwood B. Idso of the U.S. Water Conservation Laboratory, Phoenix, Ariz., challenges this conclusion with a unique set of experimental data derived from a test of a theory of his own.

Dr. Idso theorized that there is another property of the atmospheric dust which tends to conserve heat and which actually reverses the cooling trend of the first effect. This property is the ability of fine dust particles to absorb and reradiate long-wave heat radiation. The mechanism by which this property conserves heat is commonly referred to as the "greenhouse" or "atmospheric effect."

Without an atmosphere, the solar radiation absorbed by the surface of the earth and reradiated as thermal or heat radiation would escape unimpeded to space. With an atmosphere, however, much of it is intercepted and reradiated back to the earth, with the result that less heat is lost.

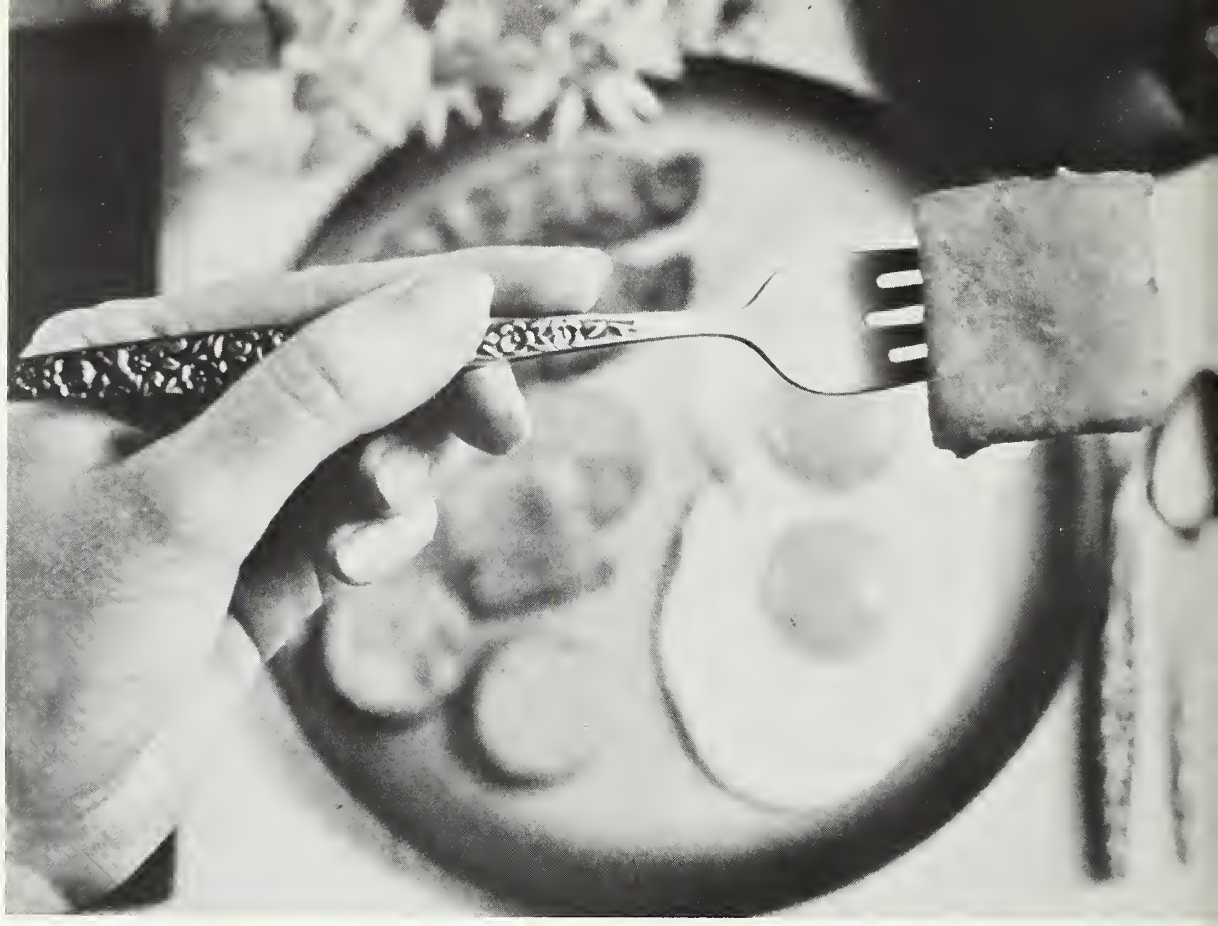
This atmospheric effect is not 100 percent efficient, however, and that's where Dr. Idso's theory comes in.

There is one region of wavelengths where practically no absorption and reradiation occurs. That region—from 8 to 13 microns—is referred to as the "atmospheric window." Much of the earth's heat radiation freely escapes in this wavelength band.

Since fine dust particles are known to absorb and radiate in this region, Dr. Idso speculated that increasing the dust concentration of the atmosphere would be just like "closing the window" on some of the escaping heat radiation and channeling its energy into a warming of the world's climate.

In testing this theory, Dr. Idso measured the incoming solar radiation and atmospheric thermal radiation from the cloudless sky one afternoon at Phoenix when a strong wind was blowing. Enough dust was blown into the air to sizably reduce the solar radiation available for heating the earth-atmosphere system. The measured increase in thermal radiation from the dusty atmosphere, however, indicated that the heat savings due to the partial "closing" of the atmospheric window by the dust was twice as great as the solar radiation loss.

The net effect of the increased atmospheric dust was thus to increase the heat balance of the earth. If such conditions persisted over the entire globe, the temperature of the earth-atmosphere system would gradually warm by approximately the same number of degrees that most scientists have previously thought it would cool. □



New rice "squares" offer a change of pace for breakfast (BN–39339).

Shaping up RICE

Big changes may be in store for that old familiar grain of rice. Instead of its usual oval shape, rice may come as squares, circles or even triangles or stars. Not only that, but those extraordinary shapes may be flavored too.

The reason is Rice Shapes, a new frozen rice product.

Made from a mixture of rice and flavor ingredients, Rice Shapes are covered with a layer of ground potato or pinto bean flakes and then partially fried to form a thin, crisp crust that leaves the interior tender and chewy. Rice Shapes show potential for increasing rice comsumption thanks to their versatility.

While tasty enough to be eaten just as a snack, Rice Shapes can also serve as the carbohydrate portion of a balanced meal or as a partial meat substitute. Moreover, they can be supplemented with protein as a food to help feed the world's poor.

Rice Shapes are the creation of engineer Charles C. Huxsoll, biologist Douglas N. Homnick, and food scientist Catherine J. Dunlap. The research was conducted at ARS's Western regional research laboratory in Berkeley, Calif.

To make this new rice product, the scientists first soak raw rice in water, bringing the moisture content up to about 40 percent. Next, they steam the rice at atmospheric pressure for about 12 minutes and then cook it for about 15 minutes at 200° to 210° F. in a steam-jacketed batch mixer equipped for intermittent stirring.

Depending on the desired flavor of the Rice Shapes, spices may be added just before cooking to insure uniform flavor. Dehydrated ingredients such as diced bellpepper or minced onion should also be added at this stage so that these ingredients receive adequate moisture and cooking.

Soy flour or other protein supplements can be added to increase the product's protein content. These supplements should be added during the last 10 minutes of cooking, however, so that the flour will not compete with the rice for moisture. Improperly cooked soy flour can cause Rice Shapes to be grainy.

Tomato paste or other highly acid ingredients should also be introduced near the end of the cooking step to prevent the rice grains from becoming tough. Low moisture ingredients such as potato or bean flakes are added last as they absorb moisture rapidly and compete with the rice for moisture.

The rice mixture can be extruded or molded immediately after cooking, but the researchers found the shaping process proceeds best when the mixture is first cooled to at least 150° F. This also allows the shapes to be more easily maintained for later processing.

After extrusion, the Rice Shapes fall onto a small, vibrating trough where a thin layer of crust material, such as ground precooked potato or bean flakes, is applied. Additional crust material is cascaded over the pieces as they are conveyed by the vibrating action of the trough. The bottom of the trough is perforated at the exit to shake off excess crust, which is reusable.

The dry-coated pieces are then steamed for several minutes to partially hydrate and cook the crust material and to prevent its loss into the frying oil. A crust of almost any desired thickness can be formed by repeatedly rolling pieces in the crust material and steaming before frying. By drying the pieces

in a stream of hot air for 2 to 4 minutes before the frying, the scientists found that they could reduce the fat content of the final product by about 20 percent. Temperature of the air stream iis 250° F. or higher; its velocity is about 550 feet per second. This pretreatment also reduces frying time from 3 to 2 minutes, while still developing a good crust.

After the frying process, the Rice Shapes are frozen at −20° to −30° F. in a blast freezer for 15 minutes.

For the housewife, preparing the frozen Rice Shapes is far simpler. She just bakes them in the oven, much like frozen french fries. For institutional use, Rice Shapes can be deep-fat fried for 1 minute at 375° F.

Rice Shapes score high on flavor—over 85 percent of a taste panel at the laboratory rated this new food in the upper half of a nine point scale. ☐

For a different and appetizing fall barbeque try "rice-ka-bobs" (BN–39338).

AGRISEARCH NOTES

Small sire breeds ease calving

MATING 2-year-old heifers to bulls of one of the smaller breeds would help cattlemen avoid many of the calving difficulties associated with mating young cows to large sire breeds.

Calving difficulty is an increasing problem in the beef industry with the use of the larger exotic breeds. Economically, calving difficulties are a major cause of calf mortality and increased labor requirements. Now, scientists know that the subsequent reproduction of the cow is also affected.

Effects of several factors on calving difficulty and the subsequent result of calving difficulty on reproductive performance were studied by ARS scientists led by Danny B. Laster, U.S. Meat Animal Research Center, Clay Center, Nebr. In the 4-year study, 1,889 Hereford and Angus cows were bred as yearlings, 2, 3, and 4 year olds. All were 2 years old at first calving. Sire breeds were Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais.

The cows were bred by artificial insemination. Calving difficulty was scored as no difficulty, difficulty, and posterior presentation. No difficulty meant the cow received no assistance or only minor hand assistance. Difficulty meant a mechanical calf puller was used or the calf was removed surgically. All calves were weighed within 24 hours of birth.

Results showed that calves sired by Charolais, Simmental, Limousin, and South Devon bulls were heavier at birth, and cows experienced more calving difficulty with these calves than with those sired by Hereford, Angus, or Jersey bulls. The percent difficulty was higher in Hereford than in Jersey-sired calves.

There was no significant difference in the percent difficulty among Charolais, Simmental, Limousin, and South Devon bulls nor between Angus and Jersey sired calves.

Overall, Hereford cows had 8 percent more difficulty than Angus cows.

In calves, an increase in 1 pound at birth resulted in a 1.05 percent increase in calving difficulty.

Cow age also had a significant effect on calving difficulty. Two-year-old cows had 36 percent more difficulty than 3 year olds, and 45 percent more difficulty than 4 and 5 year olds. Difficult births were 9 percent higher in 3 year olds than in 4 and 5 year olds.

A significant finding was that calving difficulty had a definite adverse effect on rebreeding. During a 45-day rebreeding period, the percentage of cows detected in heat was 14.4 percent lower in cows requiring assistance at calving than in those not requiring assistance. Conception rate in cows bred by artificial insemination was 15.6 percent lower in cows with calving difficulty than in those without. During the total breeding period, cows that experienced difficulty had a 15.9 percent lower conception rate.

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AGRISEARCH NOTES

Testing desert herbicide residues

IN MANY REGIONS of the country, farmers depend on rainfall or irrigation to improve microbial degradation of herbicides after application. Now, plant scientists are examining the fate of herbicides applied under desert cropland conditions.

ARS agronomist H. Fred Arle, and Keith C. Hamilton, agronomist with the Arizona Agricultural Experiment Station, Tucson, applied four herbicides to desert cropland soils at Yuma and Mesa, Ariz. Both areas had been in irrigated crop production for over 50 years, but were fallow at time of treatment.

Herbicides used were trifluralin (*a,a,a* - Trifluoro - 2.6 - dinitro-*N,N*-dipropyl-*p*-toluidine), 2,4-bis(isopropylamino) - 6 - (methylthio) - *s* - triazine (prometryne), 2 - chloro - 4 - (ethylamino) - 6 - (isopropylamino) - *s* - triazine (atrazine), and 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron). Application rates approximated those used for selective weed control in crops.

Beginning in the fall of 1968, the herbicides were incorporated by disking. Adjacent areas were treated similarly at 6-month intervals until the fall of 1970. This schedule resulted in fallow periods following application of herbicides at 24, 18, 12, 6, and 0 months before crops were planted.

All herbicides caused reductions in stands of one or more crops for relatively long periods under the dry conditions of Arizona. For example, atrazine significantly reduced stands of cabbage and sugar beets 24 months after treatment at Yuma, as well as stands of alfalfa, barley, lettuce and sugarbeets 24 months after treatment at Mesa.

Residue problems may occur where: A herbicide is applied before planting but an unscheduled crop is planted; a higher than normal rate of herbicide is applied; the herbicide is applied broadcast but only alternate furrows are irrigated; or, the herbicide is applied after crop emergence and the crop receives less than normal irrigation.

Some herbicide labels indicate that sensitive crops can be safely planted 1 or 2 years after application of the herbicides.

"This may not be true under desert cropland conditions where herbicide degradation has been retarded by low soil moisture or low temperature," the scientists' report explained.

In many desert soils the rainfall is inadequate to support normal herbicide degradation. Not only are amounts of rainfall low, but even this limited rainfall may occur when temperatures are low enough to retard microbial degradation.

No harm from feedlot runoff

IRRIGATING FIELDS with runoff collected from Nebraska beef cattle feedlots has shown no buildup of nitrate nitrogen or salt in the soil profile in two years of application.

Disposal of beef cattle feedlot runoff on growing corn is part of a continuing ARS study of management systems to limit pollution of streams and groundwater from feedlots.

Earlier, ARS scientists and agricultural engineers reported using broadbasin terraces to successfully retain runoff on lots (AGR. RES., Feb. 1971, p. 5). The idea is to capture the runoff, allow the suspended solids to settle, and periodically drain the basins by pumping the liquid through irrigation systems or into furrows. After the liquid is removed, the basin dries and the solids can be removed as desired. In those studies, the scientists weren't sure of what effect the highly enriched runoff would have on a growing crop or the soil profile.

Now, ARS agricultural engineers Charles L. Linderman and Norris P. Swanson, Lincoln, find that although there was no significant difference in yields, there was also no apparent damage to the crop or soil irrigated with runoff as compared with corn irrigated with creek water.

Five treatments included no irrigation, and furrow irrigation applications of 1.5 inches of runoff, 1.5 inches of creek water, 3.0 inches of runoff, and 3.0 inches of creek water once each week.

In two years, applications of up to 24 inches of runoff each irrigation season deposited 18 tons of total solids per acre.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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